Development of Knowledge & Press-Test based Heatset Simulator

Contributions: Laurent Grimaldi Sinapse; Gerd Carl UPM

Sinapse Print Simulators

Sinapse – Changing over Time

Artificial Intelligence – Computer-Based Training (CBT)

Real-Time Inference Engines (European Project)

Expert System for Continuous Pouring Steel Mill

Expert System for PBX (telephone) configuration

CBT systems for Gas and Electric Production/Transport

R&D project for training in High-Volume (Heatset) Printing

1st prototype of Heatset simulator

Development of other Print Simulators

Graphic Arts – Spin Off

1985----------1990 ------1995----------2000---→

Sinapse Print Simulators

Simulators – Changing over Time

SIR Heatset Web Offset

Publication gravure

Newspaper (single web)

Sheetfed Offset (SHOTS)

Flexographic & Gravure Packaging

Newspaper (Multiweb)

Educational Server (LMS)

WebSim-Heatset *Expert*

EncuPack UV Offset,

1995----------2000----- ----------2010----------2015→

Sinapse Print Simulators - 2011

- Specialised in printing /packaging simulators
- c. 2000 installed

	Products				
	SheetSim **SHOTS**	*WebSim* **Heatset**	*WebSim* News	*PackSim* Flexo	*PackSim* Gravure
Applications	**Sheetfed**	**Heatset**	**Coldset**	**Flexo**	**Gravure**
Commercial printing					
Publishing					
Newspapers					
Packaging					
Training organ.					
Suppliers					

Sinapse Print Simulators

Why Simulators ? – Same reasons as other industries

1. **Learn by doing and by making mistakes**
   *Much Less expensive on a simulator, **costs** are virtual not real*
   Carbon cost of real press run ?

2. **Active learning, not passive**
   Highest retention rate of learning methods

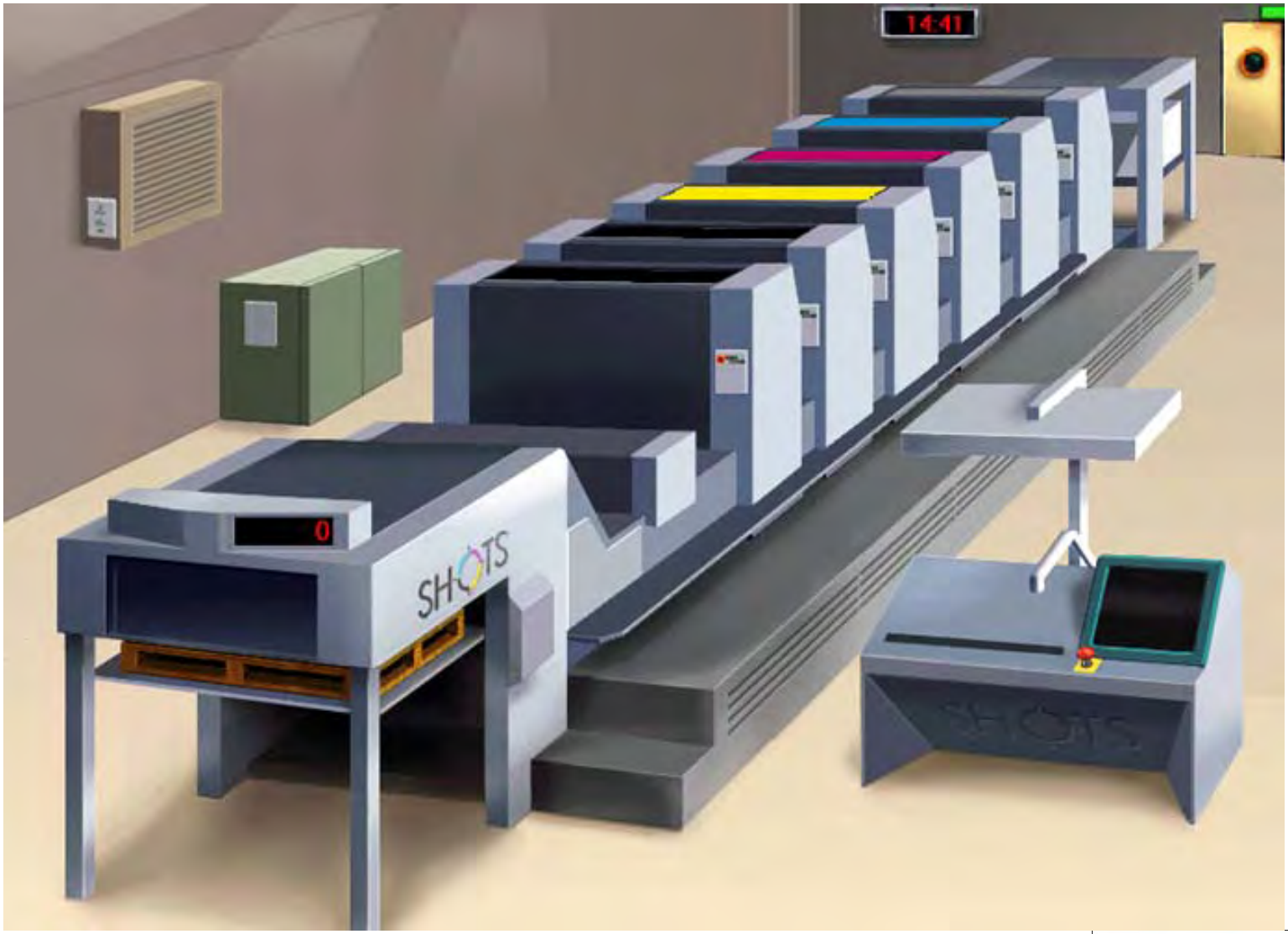
3. **Accelerated learning**
   Condense experience

4. **Structured, progressive, repeatable, documented**
   Common approach to problem-solving

5. **Objective criteria & method for evaluation**
   Get baselines, set training goals, evaluate progress

Sinapse Print Simulators

SHEETFED – 6-color



Sinapse Print Simulators

2nd (Additional) Heidelberg Interface – WorldSkills 2011

WorldSkills London

2 SM 52 presses
5 SHOTS simulators

45 countries present
14 compete in offset

Official Supplier
worldskills London 2011

Sinapse Print Simulators

HEATSET –M600 Omnicon Interface Version

4-Color

Single Web

16-page

¼ Fold

Sinapse Print Simulators

Flexo Simulators : 3 Press Types

Sinapse Print Simulators

Gravure Packaging: Reel/Reel or Cut/Crease

7-Color

Reel->Reel
(flexible)

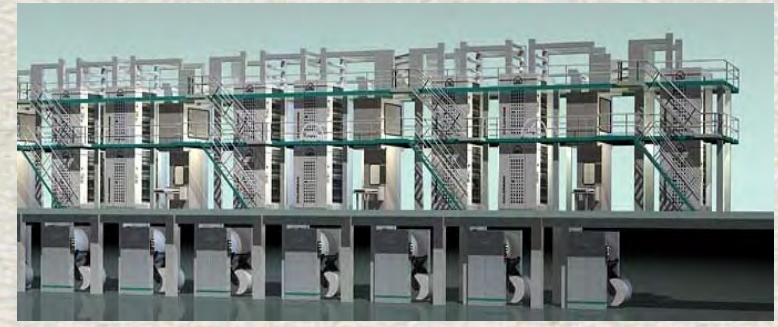
Reel->
Cut/Crease
(boxes)

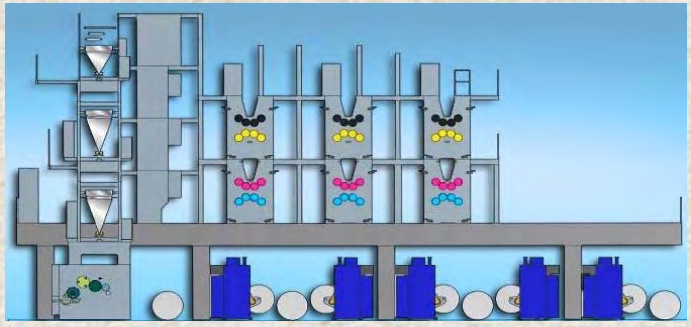
Sinapse
Print Simulators

Newspaper : Current Press Formats

(MAN, KBA, GOSS, TKS, WIFAG,…)

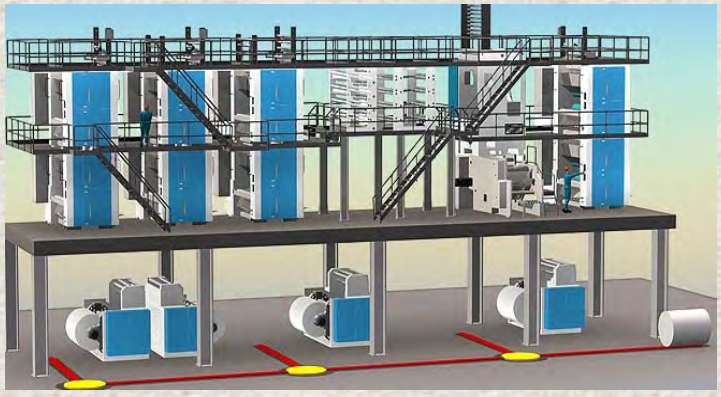
6 x 2
MAN
XXL





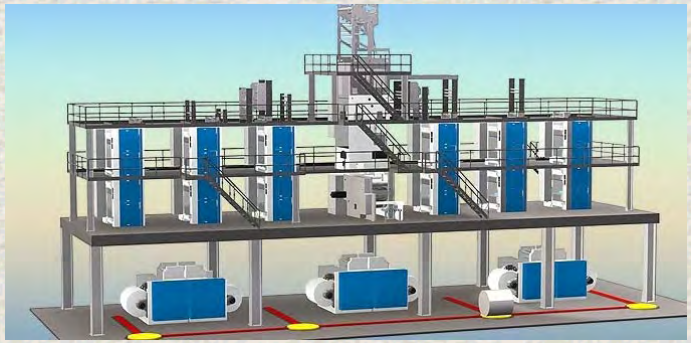
2x2,
2x3
TKS/
GOSS

4 x 2
Wifag
GOSS
KBA



4 x 1
GOSS
Uniliner
S

4 x 1
TKS
4000



2 x 1
GOSS
45/50

Development of new Heatset simulator

subject of presentation

Phase 1
F.E.G Group

- Define Variables,
- Specify Scenarios,
- Validate Visuals
- Test Simulators

3-Year Process

Sinapse
Print Simulators

Architecture – Knowledge Base

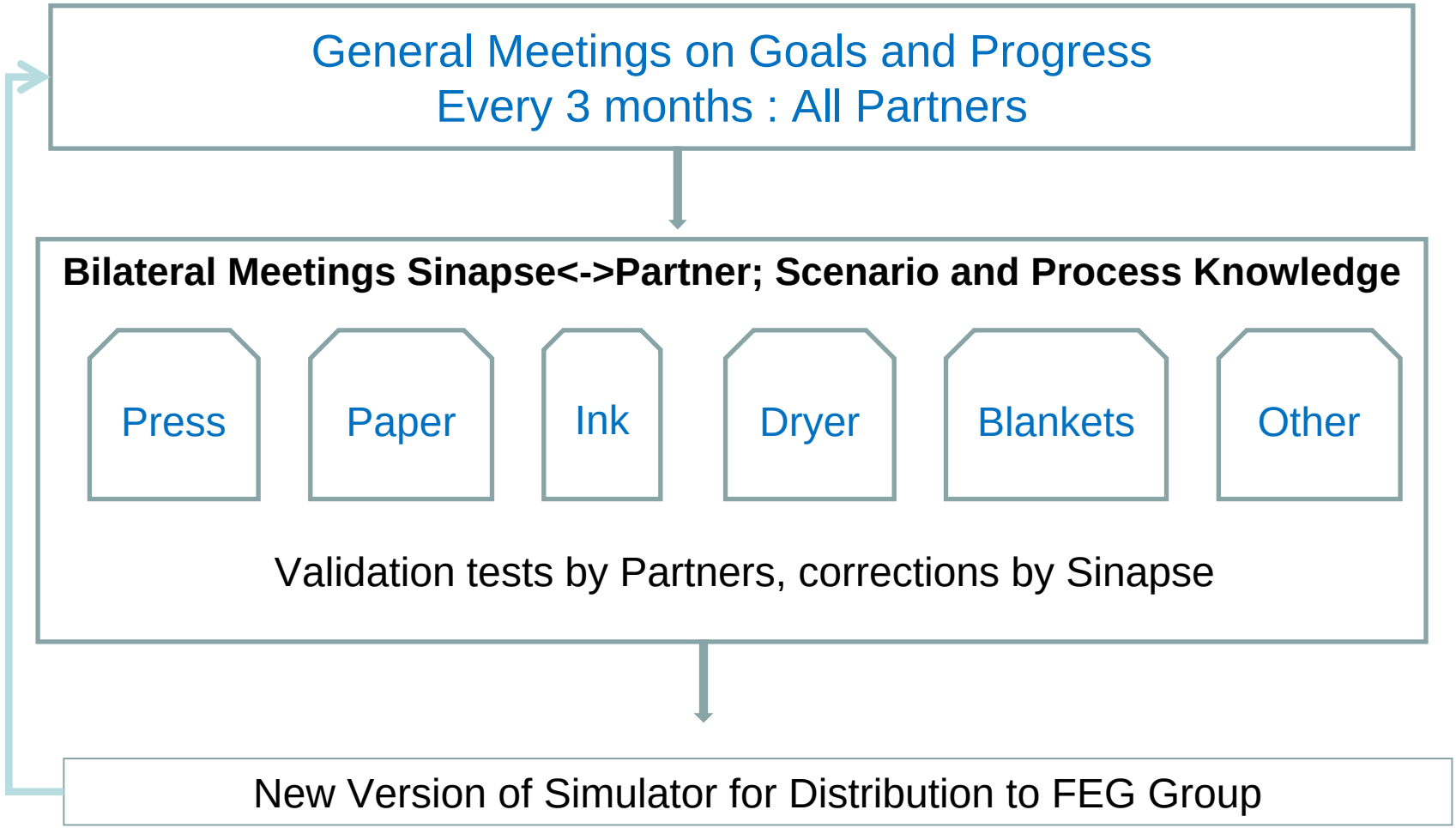
Component (mechanical, material, environmental)
- Subcomponent +
  - Attribute +
    - **Value**
      - Value range (equilibrium)
        - diséquilibria-> Process problems

This is model-driven (top down), can be used for diagnostics (bottom-up)

Process problems (behaviour)
- Downstream effects
  - Temporal Evolution
  - Effects on other components/attributes/values (-> other problems)

- Effects on system output (printed substrate)
  - Visual models

Initial systems combined static data, internal curves, heuristics


General Meetings on Goals and Progress
Every 3 months : All Partners
Bilateral Meetings Sinapse<->Partner; Scenario and Process Knowledge
Press
Paper
Ink
Dryer
Blankets
Other
Validation tests by Partners, corrections by Sinapse
New Version of Simulator for Distribution to FEG Group

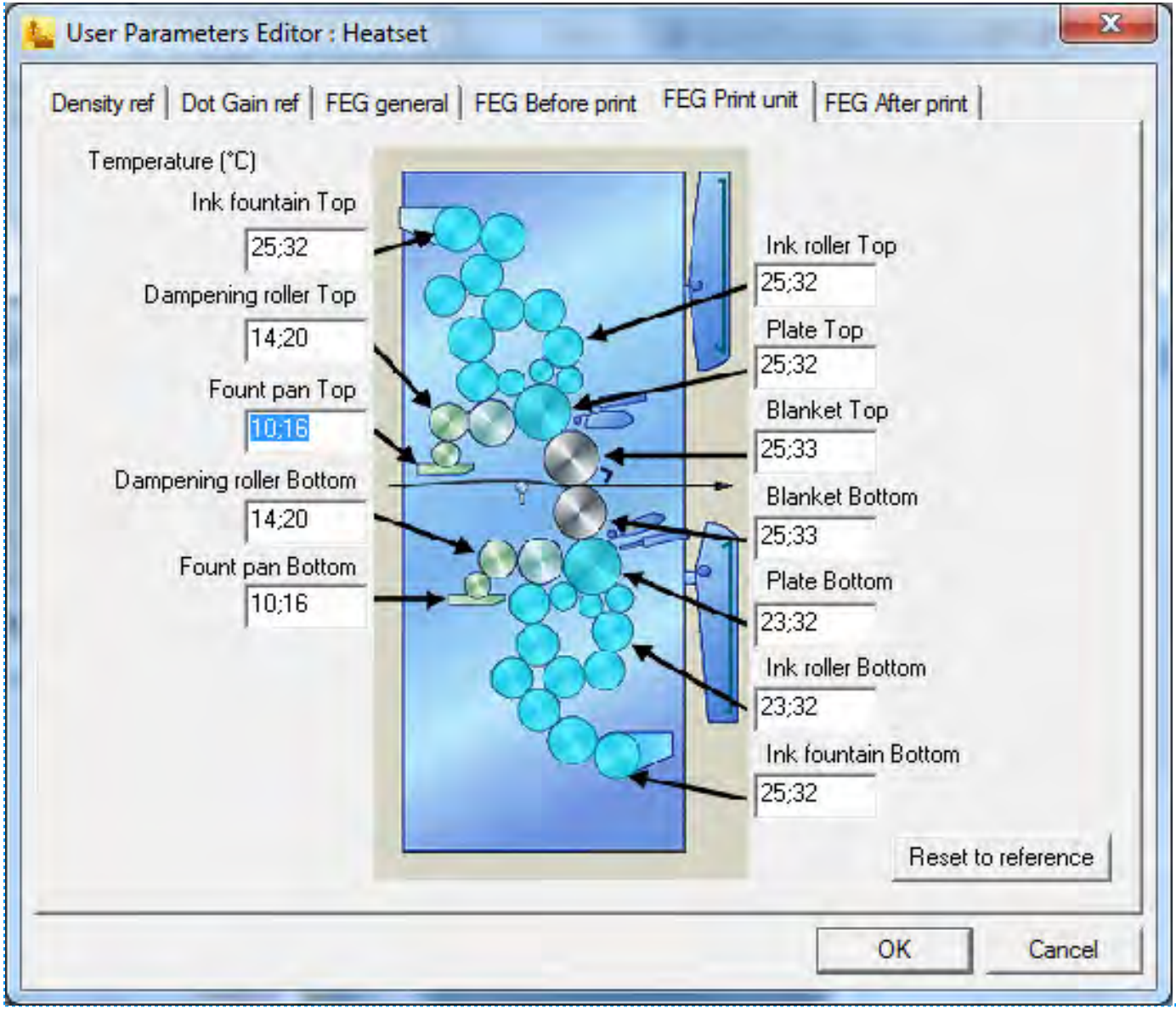
Some of the 70+ test scenarios from the FEG Group

Some « Technical Audit Scenarios » : As used by SUN Chemical

- Ink Tank temperature too low
- Current reel (paper) temperature cold
- Reel & New reel temperature too cold
- Pipe blocked
- Dampening solution T° too high
- Dampening solution T° too low
- Print unit Ink Roller T° too high (Bad settings)
- Print unit Ink Roller T° too high (not enough lubrication)
- Print unit Ink Roller T° too high (set too high cooling system)
- Print unit Ink Roller T° too high (failure cooling system)
- Print unit Ink Roller T° too high (cooling pipes blocked)
- Print unit Ink Roller T° too high (cooling system set too low)
- Fount roller T° too high (Fount Roller lubrication poor)
- Plate T° too high (Plate cylinder packing too thick)
- Blanket T° too high (Blanket packing too thick)
- Chill roller Temperature set too low
- Chill roller Temperature set too high
- Chill roller cooling system blocked

Sinapse Print Simulators

Sample of implementation in the Simulator



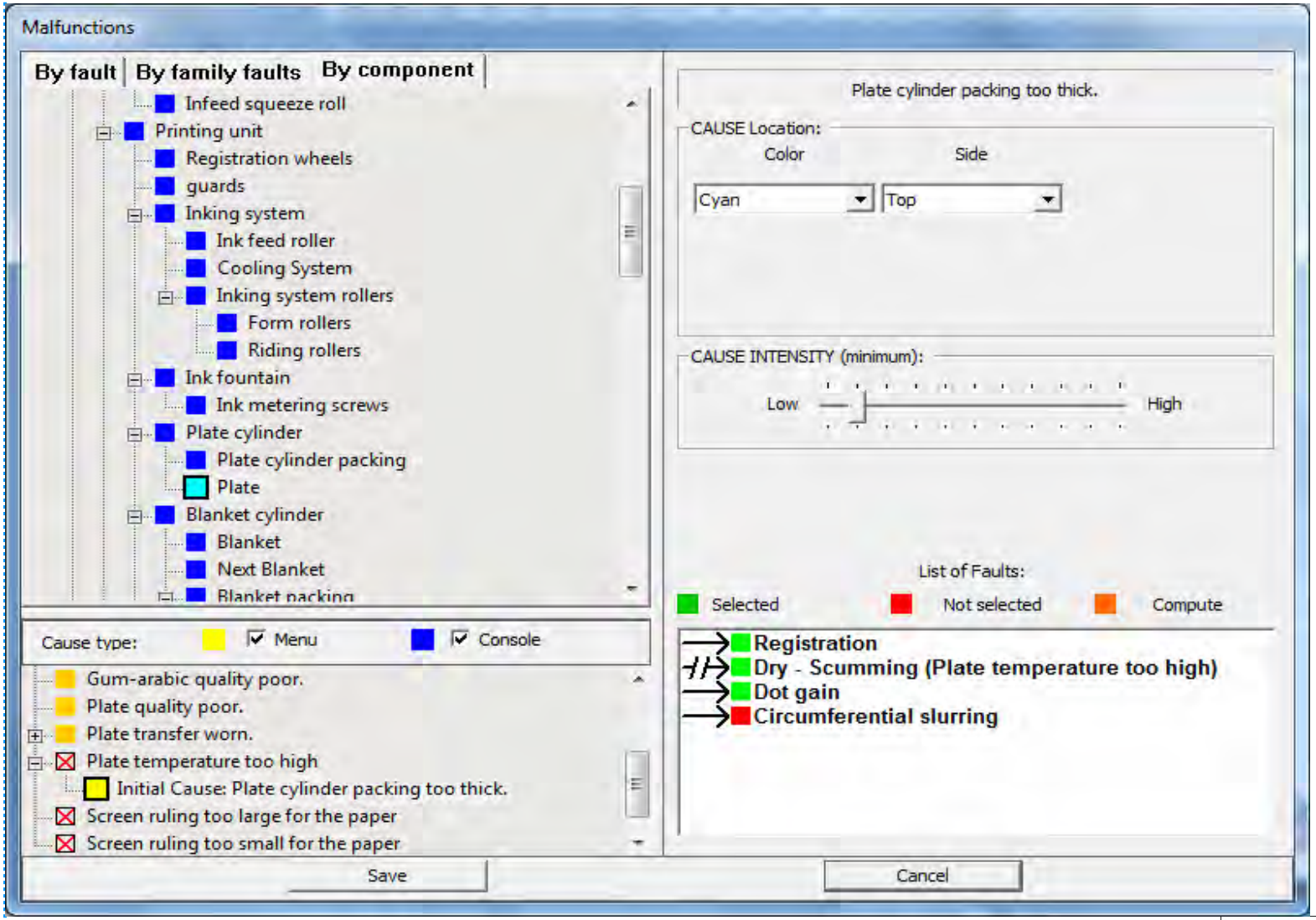
User References

Problem value is calculated as difference from defined reference/range

Values can thus be adapted to print shop practice or supplier recommendation

Temperature is one attribute/component there are many.

Part of Knowledge Base, Scenario Generator, Help System



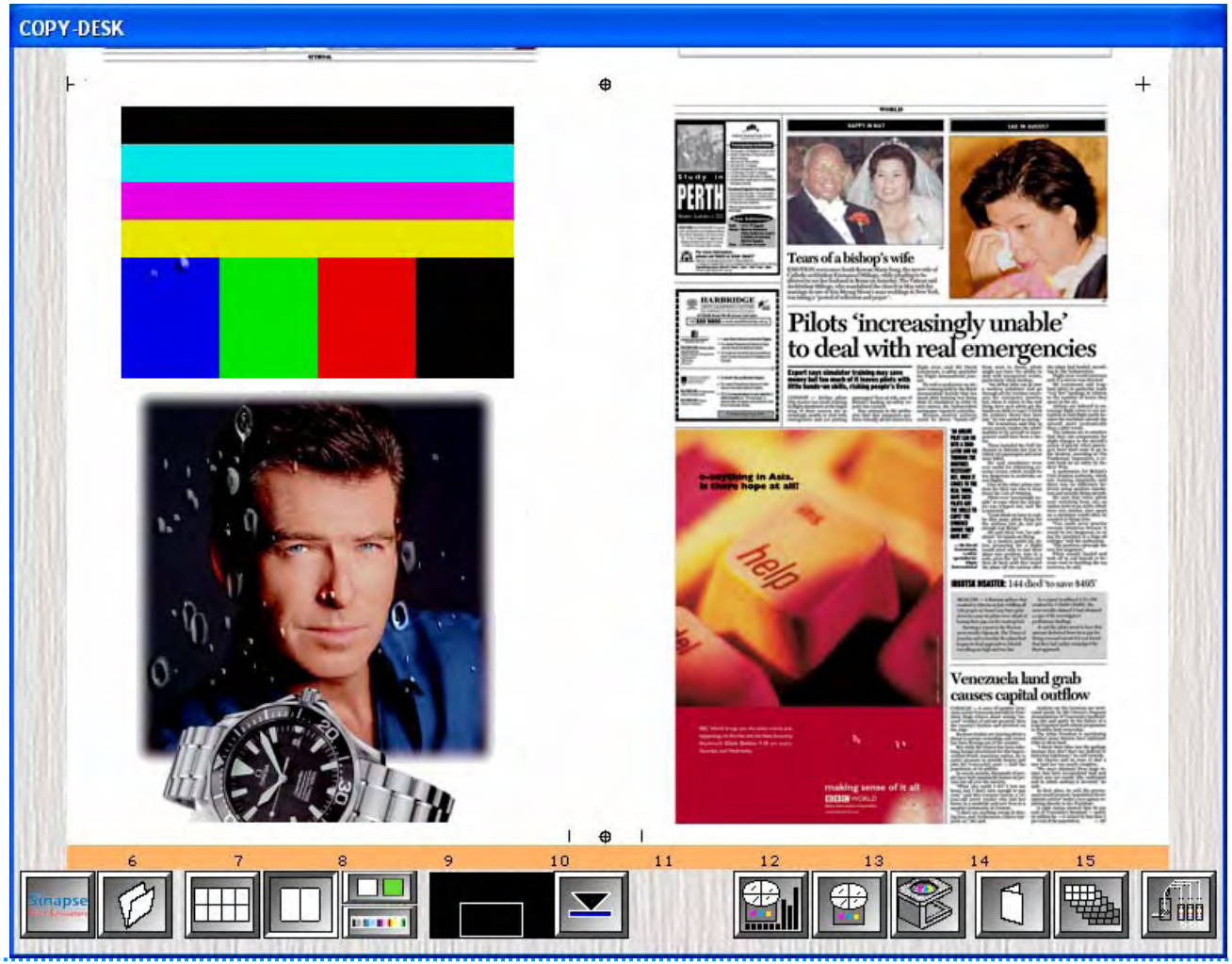
Showing « Top-down » view

Example: variable, scenario, visualisation

Causes : dryer temperature too high

S1 Direct : Through the Dryer area3 temperature adjustment

S2 Induced : Through a wrong drying profile (drying too fast)



Scenario :

S1 : Blistering - Dryer Temperature Too High

S2 : Blistering - Wrong Dryer Profile (Too High)

Note: only valid for LWC paper, not for SC

Step 2 :PPD project : UPM, VTT, Sinapse

Paper-based modelling in Heatset

3 calendar years

UPM Reasons for Extending Simulator

Reproduced from 2009 presentation by Gerd Carl of UPM:
Sinapse Simulators in UPM Printing Process Workshops

Share knowledge inside UPM

Our own team of Technical Sales Managers need to broaden their field of knowledge with more printing processes and need to maintain their skill levels

-Our customers' world is changing

Less skilled people are available to share their knowledge with younger people after the big wave of Experts went to retirement between 2008 and 2015

Deeper Model of interaction : 15 faults, 9 paper types

Paper	Type	Name	Fault n°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
				Blistering	Print through	Positive piling	Negative piling	Mechanical Ghosting	Cracking of coating	Fiber cracking	Fiber puff	Dot gain / Density / Scumming	Linting	Fluting	Static electricity	Scuffing	Dusting	Smearing
1	NP	UPM News 45 g		0	1	1	0	0	0	1	0	1	1	0	?	0	1	0
2	SC-A	UPM Max 52 g (SC example)		0	1	1	0	0	0	1	1	1	1	0	1	0	1	0
3	SC-A+	UPM Smart 52 g		0	1	1	0	0	0	1	1	1	1	0	1	0	1	0
4	LWC gloss	UPM Cote 60 g (LWC example)		1	0	1	1	1	?	1	1	1	0	1	1	0	0	1
5	MFC	UPM Matt 54 g		0	?	1	1	?	?	1	1	1	0	0	?	?	1	1
6	MWC matt	UPM Star M 80g		1	0	1	1	1	1	1	0	1	0	1	0	1	1	1
7	WFC gloss	UPM Finesse Gloss 90 g		1	0	1	1	1	1	1	0	1	0	1	0	0	0	1
8	WFC light matt	UPM Finesse Classic Matt 70 g		1	0	1	1	1	1	1	0	1	0	1	1	?	1	1
9	WFC heavy matt	UPM Finesse Matt 130 g		1	0	1	1	1	1	0	0	1	0	1	0	1	1	1

- Density and dot gain **curves** were based on versatile printing trials in HSWO press. Ink feed and fountain solution feed curves were made for nine papers with two different ink and different screen ruling. *Trial data was modified for simulator to better respond for learning and training purposes (see **curve editor** below)*
- Fault **behaviour** was based on available data, practical experience on printing and discussions between different experts of printing and paper making

Leo Hertzen : VTT

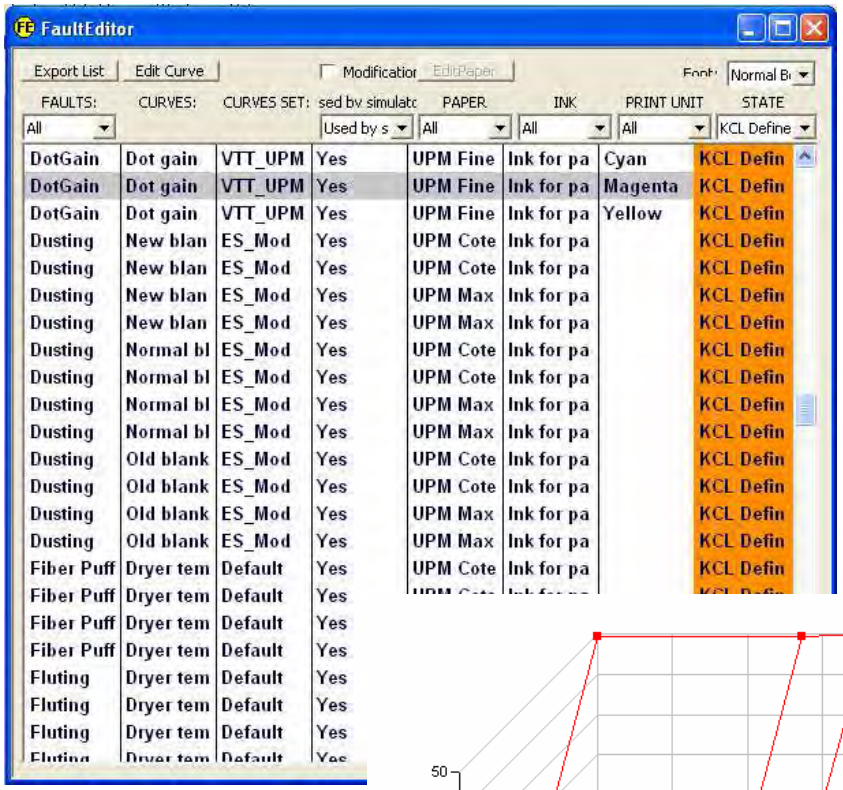
Sinapse Print Simulators

Data matrixes from VTT **Press tests**: per paper, per set of variables

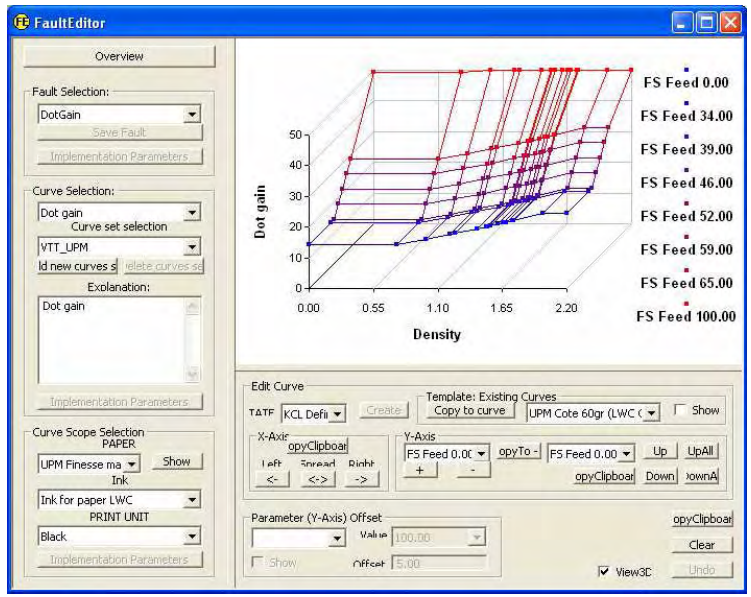
Print	Ink duct speed	Ink screw opening	Fount step (%)	FS duct speed	Screen resolution	Control bars	Filter	Solid density	25%	50%	75%	Dot gain 25 %	Dot gain 50 %	Dot gain 75 %	Density at 25%	Density at 50%	Density at 75%	Dot gain 25 %	Dot gain 50 %	Dot gain 75 %
67-45.Black	37	41	2	120 lpi-5345l/cm		1B		1,48	67,2	91,8	98,1	0,48	0,12	0,03	0,992	1,355	1,448	67,9	48,9	24,8
67-45.Black	37	42	2	120 lpi-5345l/cm		2B		1,41	64,1	91,1	98,6	0,51	0,13	0,02	0,946	1,345	1,455	67,3	49,3	25,4
67-45.Black	37	28	2	120 lpi-5345l/cm		3B		1,34	58,2	87	98,5	0,56	0,17	0,02	0,859	1,284	1,454	65,3	49,3	26,1
67-45.Black	37	28	2	120 lpi-5345l/cm		4B		1,39	55,6	85,9	96,9	0,62	0,20	0,04	0,821	1,268	1,430	63,5	48,6	25,3
67-45.Black	37	27	2	120 lpi-5345l/cm		6B		1,19	44,8	75,7	93	0,66	0,29	0,08	0,661	1,117	1,373	58,6	48,8	27,4
67-45.Cyan	47	49	2	120 lpi-4845l/cm		1C		1,47	51	81,9	96,3	0,72	0,27	0,05	0,753	1,209	1,421	60,2	47,1	24,6
67-45.Cyan	47	55	2	120 lpi-4845l/cm		2C		1,49	47,5	79,6	95,6	0,78	0,30	0,07	0,701	1,175	1,411	57,8	46,4	24,3
67-45.Cyan	47	47	2	120 lpi-4845l/cm		3C		1,37	44,5	74,1	93,4	0,76	0,35	0,09	0,657	1,094	1,379	56,5	46,1	25,1
67-45.Cyan	47	48	2	120 lpi-4845l/cm		4C		1,32	41,7	73,6	94,1	0,77	0,35	0,08	0,615	1,086	1,389	54,6	46,4	25,7
67-45.Cyan	47	44	2	120 lpi-4845l/cm		6C		1,05	39,4	70,7	89,6	0,64	0,31	0,11	0,582	1,044	1,322	56,0	49,9	29,6

Sinapse Print Simulators

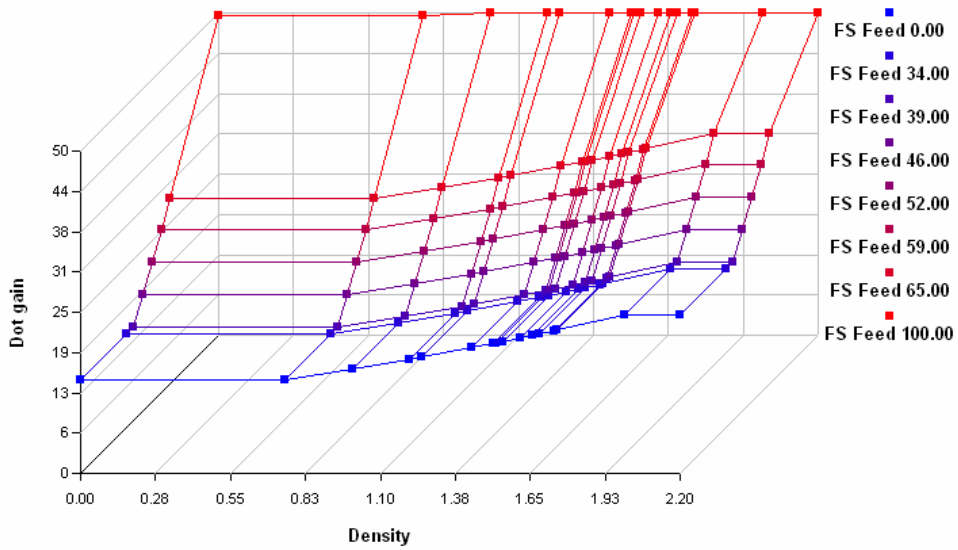
VTT data -> entry in table of papers, problems, curves



Table

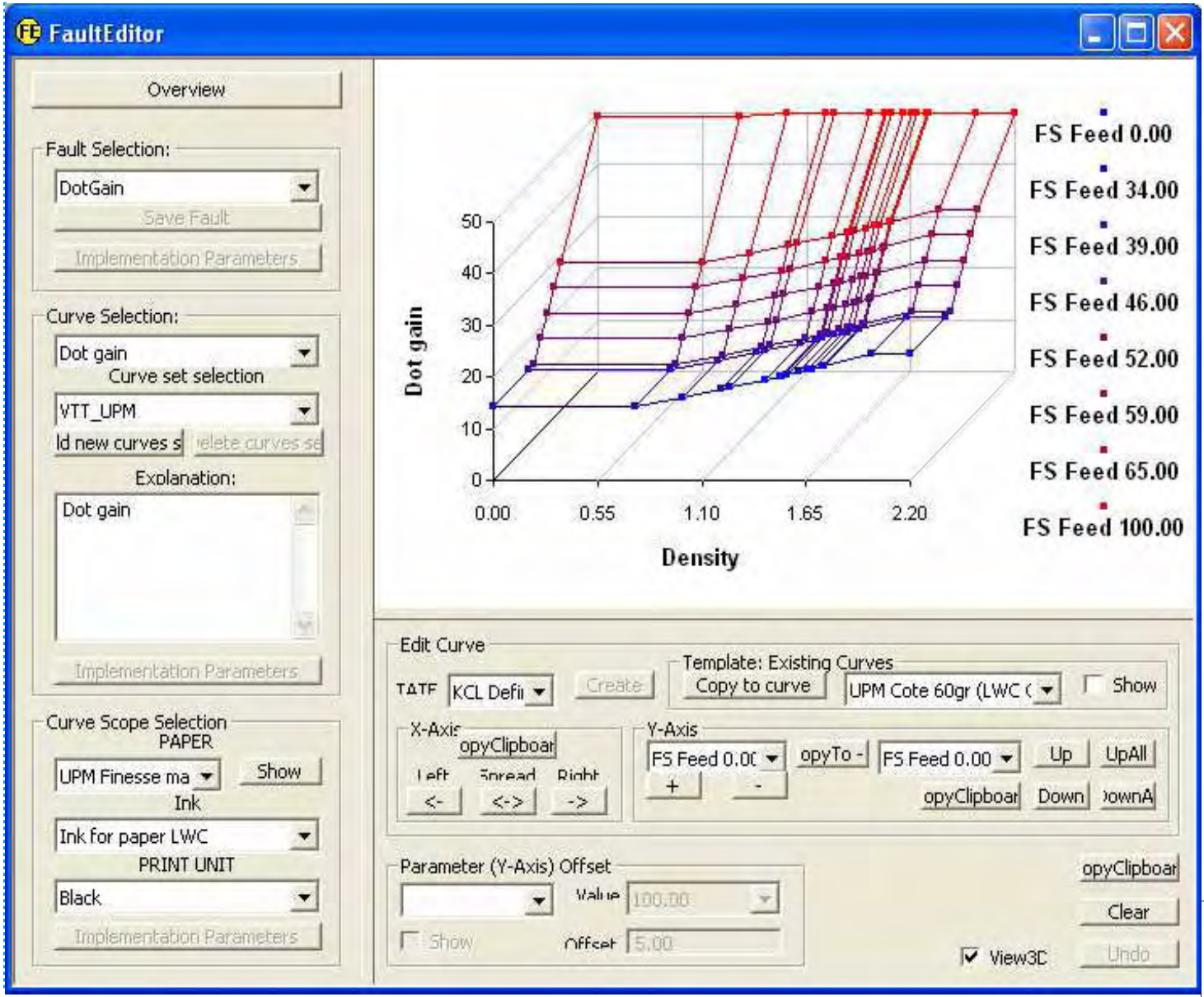


Curve Editor



Curve used by Simulator

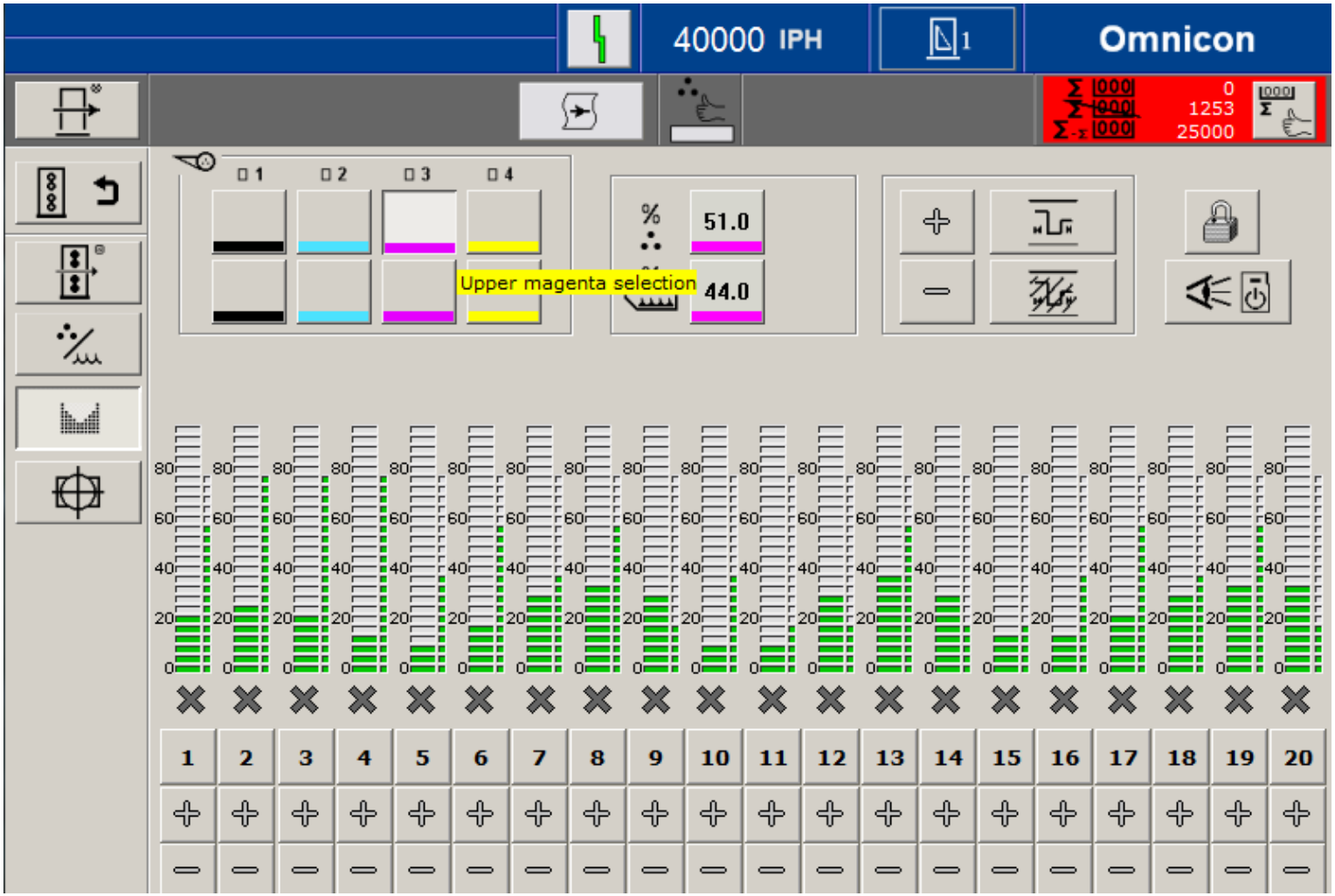
Curve Editor : Allows UPM to modify/generalize behavior



If Print Experts think original curve too narrowly defined for training, They can adjust it.

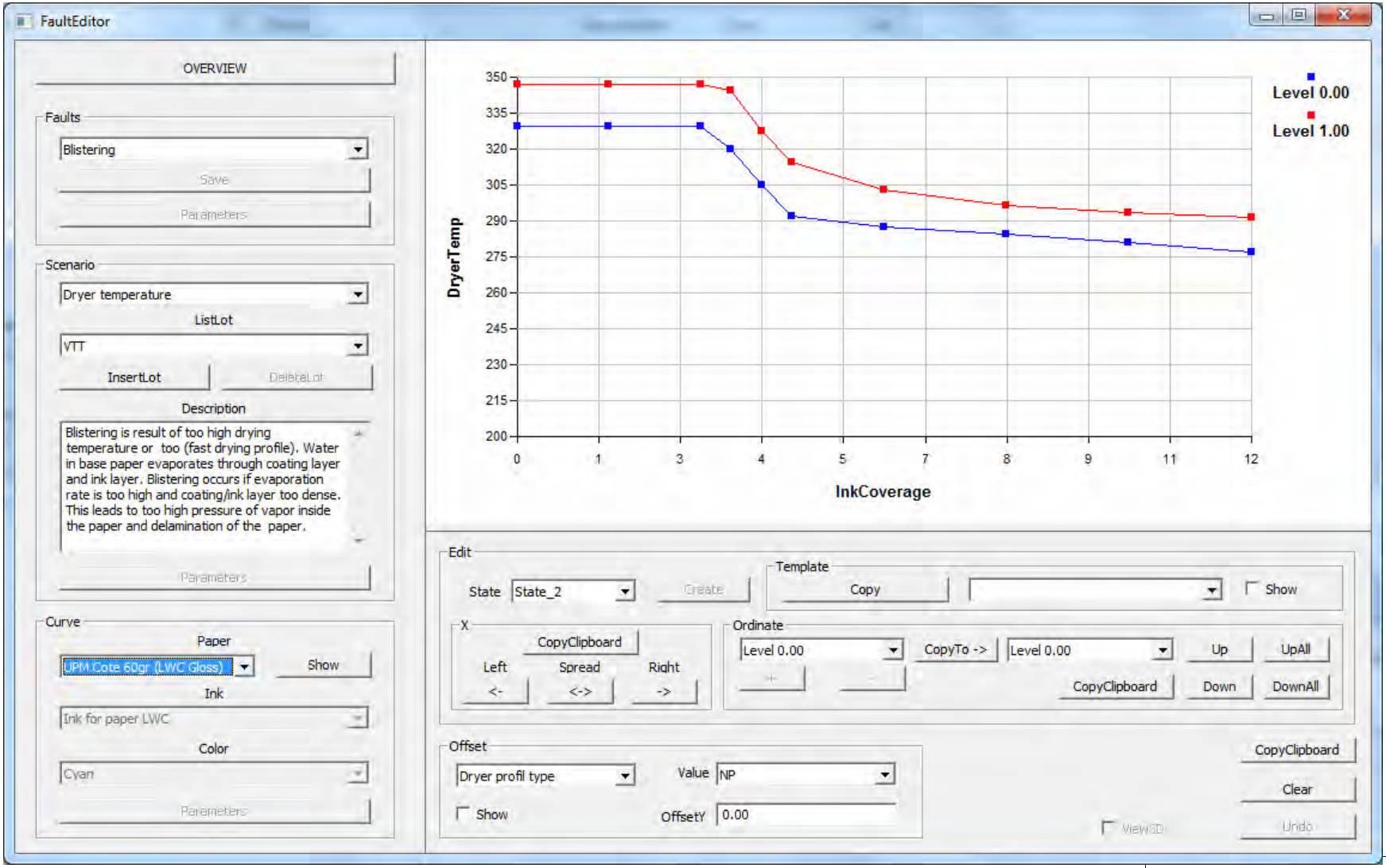
Curve orignally = set of data from 1 press run. Each press run is individual.

Press Console – inking– Operator modifies density



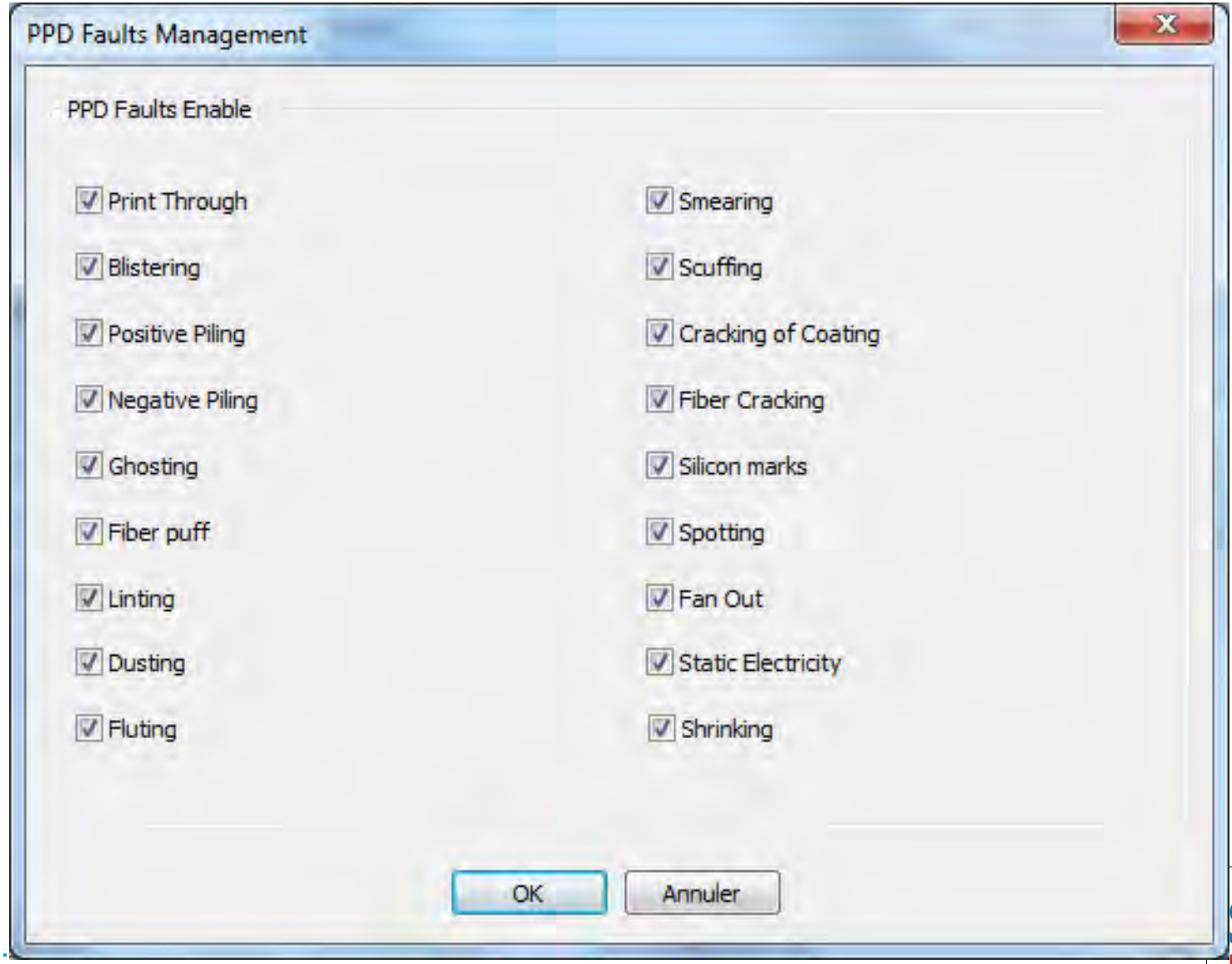
Sinapse Print Simulators

Curve for blistering: min/max thresholds



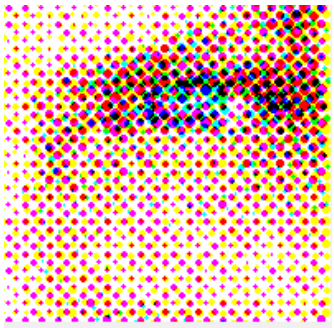
Sinapse Print Simulators

PPD Faults too sophisticated for some : can be turned on/off

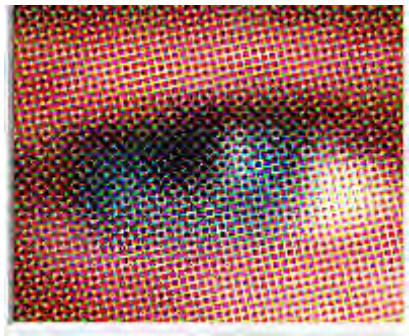


Lack of Heatset knowledge is becoming a problem in training centers and in companies

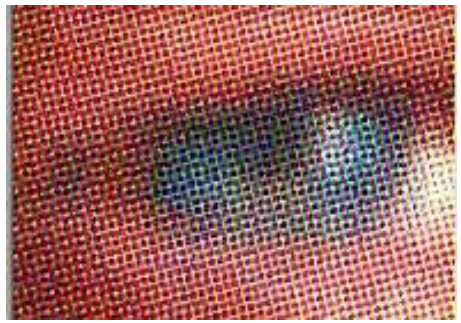
Better Representation of Process : Magnified Dots



Old Version



New – SC Paper



New – LWC Paper

SC/LWC : different inks, screens, dryer profiles, plates, behavior

Sinapse Print Simulators

Examples of Current Use of HEATSET EXPERT version

UPM Training Centers in Europe/China

Simulator integrated into press console

Like Flight Simulator

'Cockpit' for printers

Sinapse Print Simulators

UPM Training : 2009:beginner/intermediate level, 2011 added expert level

The Biofore Company UPM

No	Date	Process	Language	Level
1	29.04.2009	SFO	English/german	beginner
2	12.05.2009	HSWO	English	beginner
3	26.05.2009	HSWO	German	intermediate
4	03.06.2009	optional	English	open
5	16.06.2009	HSWO	English	intermediate
6	07.07.2009	SFO	English	intermediate
7	09.07.2009	HSWO	English	intermediate
8	08.09.2009	optional	English/ german	open
9	23.09.2009	HSWO	German	intermediate
10	29.09.2009	CSWO	English	beginner
11	06.10.2009	HSWO	English	beginner
12	21.10.2009	SFO	German	beginner
13	27.10.2009	SFO	English or spanish	beginner
14	05.11.2009	optional	English/german	open
15	11.11.2009	CSWO	English	intermediate
16	24.11.2009	optional	English	intermediate

UPM has access to **all** paper types.

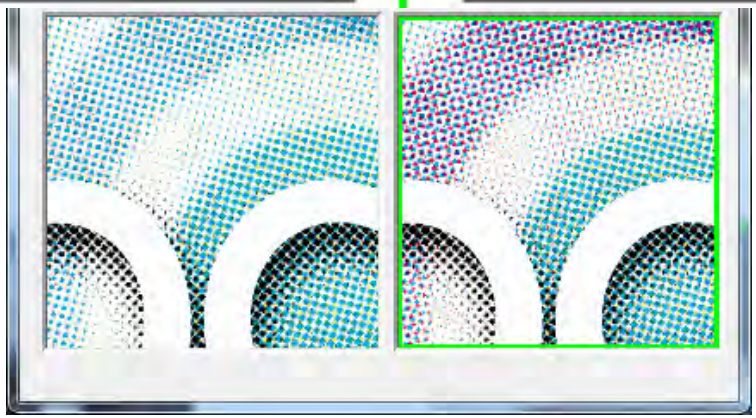
Commercial heatset version currently has SC/LWC available.

Other paper types will be introduced over time.

Sinapse Print Simulators

Sample UPM print job – low M density, magnifier and dots

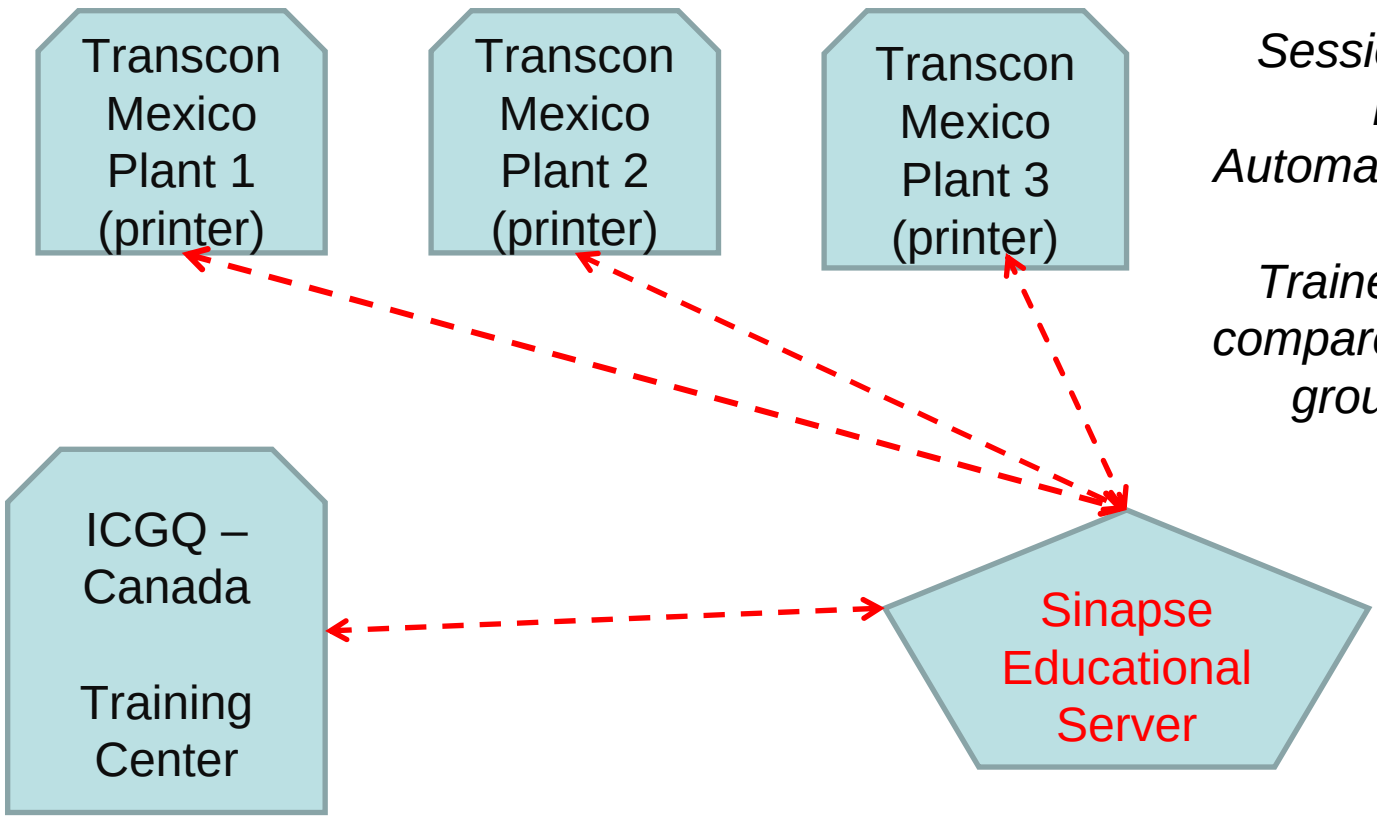
Current print



Color OK

Sinapse Print Simulators

Transcontinental- Training in Mexico: Remote Supervision



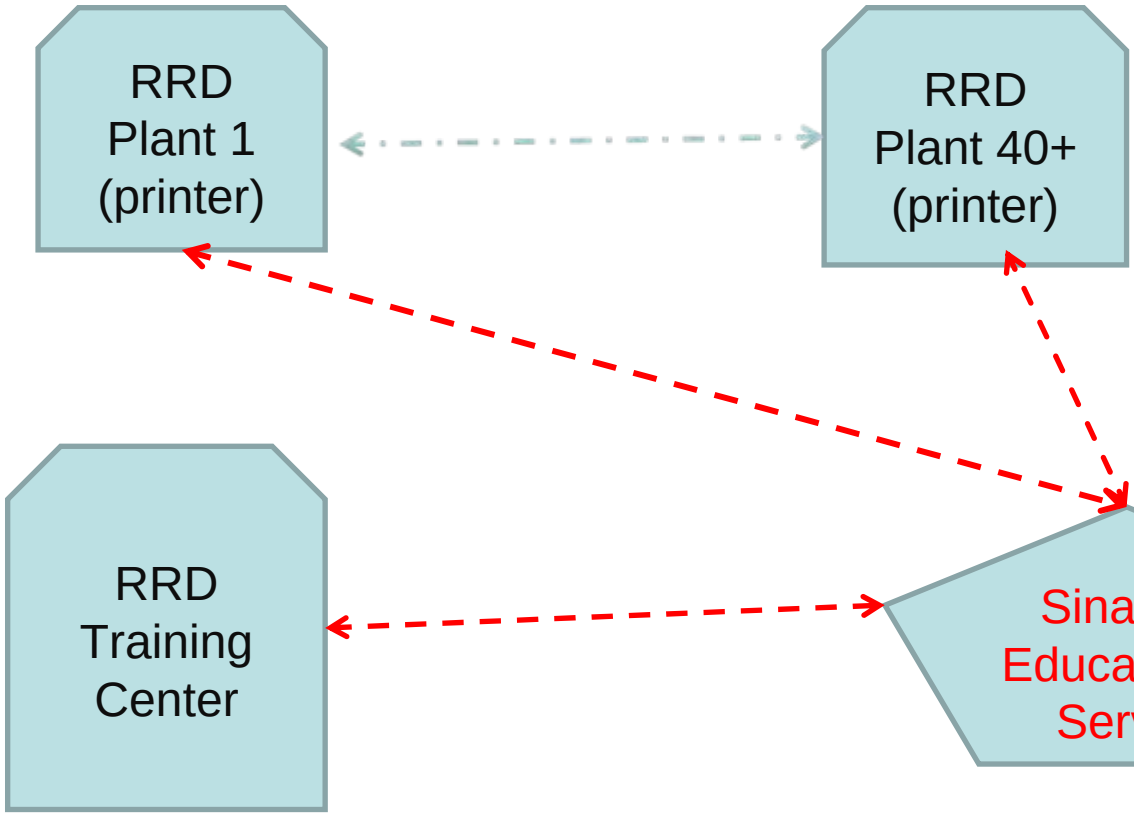
Sessions sent over internet. Automatically analysed

Trainers follow and compare individual and group progress.

Exercises: Learner Level, Production Problems, Training Goals

RR Donnelley in USA: Remote Supervision

RRD requirements for training: *Technology Driven, Self Guided, On-Site*



Sessions sent over internet. Automatically analysed

Trainers follow and compare individual and group progress.

Exercises: Job Description, Production Problems, Training Goals

Sinapse Print Simulators

RRD Trainers : Working on Problem Solving

Danville KY, Crawfordsville and Roanoke discussing simulator

40+ RRD plants participate in Simulator-based Training

Sinapse Print Simulators

Sample RR Donnelley Print Job

SHOTS Heard Around the World: Contest 2011-2012

Team Competition (max 5 per team)

Nov 2011 : 1st Round : ‘n’ teams; Individual scores* -> Team Average
Dec 2011 : 2nd Round : n/2 teams; Individual scores -> Team Average
Jan 2012 : 3rd Round : ‘n/4’ teams; Individual scores -> Team Average

•*Score= virtual production cost*

Individual Competition – Best from top 8 Teams

Feb 2012 : Quarter Final: 8 Individuals (from 8 top teams)
Mar 2012 : Semi Final: 4 Individuals

FINALS – LIVE – (paid trip) at DRUPA
May 2012 : 2 individuals

Partners

The Biofore Company UPM

Advancing Graphic Communications
PRINTING INDUSTRIES OF AMERICA

Sinapse Print Simulators

European Project Partnership: FP7 – proposal for 1.2012

WP 2011-2012 Objective 8.1 Technology enhanced Learning

Sinapse is interested in discussing this with potential partners

Subjects of interest include:

1. Avanced learning analysis
2. Learning networks combining industry and education
3. Distributed learning systems
4. Process modeling
5. Curriculum development
6. Augmented Reality in learning

Sinapse Print Simulators

Thank you for your attention: questions are welcome

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